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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE



Applicants: J.G. BEDNORZ ET AL. : Date: March 29, 1988
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FOR: NEW SUPERCONDUCTIVE COMPOUNDS HAVING HIGH TRANSITION TEMPERATURE,
AND METHODS FOR THEIR USE AND PREPARATION

DECLARATION OF CHANG C. TSUEI
WITH RESPECT TO HIGH T_c SUPERCONDUCTIVITY

Commissioner of Patents and Trademarks
Washington, D.C. 20231

Sir:

I, Chang C. Tsuei, hereby declare and say that:

1. I have a PhD in Material Science from California Institute of Technology, and worked approximately eleven years as a student and faculty member at Cal. Tech. During this time, my research was primarily on amorphous materials and superconducting materials. I joined the Thomas J. Watson Research Center of IBM Corporation in Yorktown, N.Y. in 1973 and continued my work on amorphous materials. For several years, I have been the Manager of a group in the Physical Sciences Department studying amorphous superconductivity and superconductivity of new High T_c superconducting ceramic materials.

2. On approximately September 13, 1986, I returned from a sabbatical at the K. Onnes Laboratory in Holland. Upon my return, I saw a copy of an IBM activity report for May - June, 1986, in which the "novel research" of J.G. Bednorz and K.A. Mueller was described. These individuals were working in the Zurich, Switzerland research laboratory of IBM Corporation, and had observed a steep decrease of resistivity in sintered samples of Ba-La-Cu-oxides. A true copy of this activity report is attached hereto and labeled Exhibit A. On page 2 of the activity report the resistivity versus temperature plot is shown in Figure 1

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wherein the onset temperature for superconductivity is in the 35K range. The data and measurements discussed in the activity report were later published by Bednorz and Mueller in Z. Phys. B-Condensed Matter, 64, pp. 189 - 193 (1986), a true copy of which is attached and labeled Exhibit B. Based on my previous experience in superconductivity, I was very interested in the work of Bednorz and Mueller and discussed this work with my colleague, Richard Greene (who reported to me). I told Greene to review this activity report and to start a project on high T_c superconductors of the type described by Bednorz and Mueller. This project was started by Richard Greene and others in the group that reported to me, almost immediately.

3. I called Alex Mueller in Switzerland via telephone to request samples of his superconducting material, as well as to discuss the technical area with him. I also sent computer messages to Mueller, but could not contact him. After this, early in October, 1986, I obtained a copy of the aforementioned Z. Phys. B article by Bednorz and Mueller.

4. I knew that on approximately October 17, 1986, Praveen Chaudhari was in Zurich, Switzerland. I was told that he was given samples of the Bednorz and Mueller superconducting copper oxides to bring to the U.S. for collaborative work in the United States. I was also told that these superconducting samples were delivered to Richard Greene on or about October 22, 1986. Shortly after these superconducting samples were received, I began work to confirm the existence of high temperature superconductivity in these materials and instructed Sung Il Park to assist me. To do so, small pieces of these samples were cut by Park and Greene and were prepared with indium contact dots to which copper wires were attached. These copper wires were attached to a source of electrical current and to voltage-measuring equipment to determine the existence of the superconducting state. As the temperature of the sample was lowered, resistivity versus temperature plots were then made using standard laboratory techniques. The preparation of these samples for measurement was done by Sung Il Park, who reported to me and who was directed by me to do so.

5. A true copy of the cover sheet and a page of my laboratory notebook is attached hereto and labeled Exhibit C. On the second page of

this exhibit, two diagrams illustrate the samples and show the location of the indium contact dots on the superconducting samples and the numbering given to the copper wires attached to these dots. This numbering enabled us to properly connect these wires to a current source and to voltage-measuring equipment. All entries on this notebook page were made by me. The samples are generally designated by their composition, the term "BLCO" standing for Ba-La-Cu-Oxide materials. The designation "BLCO 21 -- II," etc. in the box in the right hand corner of this page and the designation "BLCO 2 I" in the circle in the middle of the page were the designations on the sample boxes in which the samples were located. I copied these designations directly into my notebook. On the bottom right hand corner of this exhibit, the words "dewar pumped 3×10^{-5} Torr 11/9/86" is indicated. I made this notation on November 9, 1986 indicating that the dewar was being pumped down in order to enable the resistivity versus temperature measurements to be made. Because this dewar leaked, the actual measurements had to be made within several hours of the pump-down.

6. The individual superconducting samples were attached to a long probe and slowly lowered into the liquid helium dewar while a current was passed through the sample and the voltage across two of the terminals measured. Sung Il Park assisted me. These measurements were recorded directly on an xy recorder which plotted resistivity versus temperature for these superconducting samples. These plots indicated an onset of superconductivity at about approximately 35K, and confirmed the results of Bednorz and Mueller in Switzerland. As an example, referring to the sample BLCO 2 having connecting wires 20, 21, 22 and 8, electrical current was applied between wires 20 and 8, while voltage measurements were made across the sample using contact terminals 21 and 22. Since the voltage is a function of the resistance of the material, by making the voltage measurements at constant currents, resistivity versus temperature plots can be developed. These resistivity versus temperature plots appear to be missing at this time. I believe that they may have been inadvertently thrown away when the laboratory was subsequently extensively cleaned.

7. During my measurement of the superconducting samples described hereinabove, Bradford G. Orr, who was a Post-doctoral employee

at the Research Center, came into my lab and observed these measurements, as did Albert M. Torressen. These measurements confirmed the high temperature superconductivity of these materials and I was enthusiastic about the results. I expressed my enthusiasm to Richard Greene, who was anxious to do specific heat measurements on these samples. Subsequent to my confirmation of their resistivity versus temperature measurements, I contacted Mueller in Zurich to inform him of my successful resistivity versus temperature measurements. In addition, I told several people about my laboratory measurements, including Arthur Williams, Alex Malozemoff, Paul Horn, and Praveen Chaudhari, all of whom work in the Thomas J. Watson Research Center.

8. From the time we received the superconducting samples in October, 1986 to the present, I, Richard Greene and Sung Il Park have worked on a daily basis to further explore and develop this technology. In particular, I observed Greene working on a daily basis to conduct specific heat measurements during November and December, 1986.

9. All acts described hereinabove relating to sample preparation, measurement and discussions of these measurements occurred in the United States.

10. I further declare that all statements made hereinabove are of my own knowledge and are true and that all statements made on information and belief are believed by me to be true. Further, I declare that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of a Patent Application or any patent issuing thereon.

Chang C. Tsuet

CHANG C. TSUET

DATE: 3/30/88